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AF/2872 #

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of

Akihiro MURATA et al.

Application No.: 09/509,669

Filed: April 4, 2000

For: OPTICAL MODULE

Group Art Unit: 2872

Examiner: A. AMARI

Docket No.: 105895

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BRIEF ON APPEAL

Appeal from Group 2872

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I. INTRODUCTION

This Appeal is from an Office Action mailed June 16, 2003, finally rejecting claims 1-12 and 16-18 of the above-identified patent application. No claims are allowed.

A. Real Party in Interest

The real party in interest for this Appeal and the present application is Seiko Epson Corporation, by way of an assignment recorded in the U.S. Patent and Trademark Office at Reel 010976, Frame 0832.

B. Statement of Related Appeals and Interferences

There are presently no appeals or interferences, known to Appellants, Appellants' representatives or assignee, which may directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

C. Status of Claims

Claims 1-12 and 16-18 are pending, stand rejected, and are on appeal. The claims on appeal are set forth in the attached Appendix. Claims 1, 4, 17 and 18 are independent. Claims 2-3 depend from claim 1. Claims 5-12 and 16 depend from claim 4.

D. Status of Amendments

All claim amendments have been entered of record.

II. SUMMARY OF THE INVENTION

A. Related Art Problems Overcome by the Invention

An optical module is a transducer from electrical energy to light, or from light to electrical energy. An optical module is constituted in hybrid integrated form by an optical element, an optical waveguide, an electrical circuit, and the like. An optical module is used, for example, in an optical fiber communications system.

Fig. 3 schematically shows the disposition of an optical waveguide and optical element in a conventional optical module. This is disclosed in the journal *Optical Technology*

Contact Vol. 36, No. 4 (1998). On a principal surface of a mounting substrate 40, a depression 42 is provided. In the depression 42 is mounted an optical element 44. On the principal surface of the mounting substrate 40 is fitted an optical waveguide 46. The end portion 48 of the optical waveguide 46 is positioned over the optical element 44. The end portion 48 forms a mirror. Light 50 emitted by the optical element 44 is reflected by the end portion 48, and enters the core 52 of the optical waveguide 46. The light 50 proceeds in the direction shown by an arrow within the core 52, and is transmitted through the optical fiber or the like.

However, this requires both alignment accuracy when mounting the optical element on the mounting substrate and alignment accuracy between the mounting substrate on which the optical element is mounted and the optical waveguide. In particular, for an optical module such as an optical fiber requiring positioning accuracy with an error of ±1 to ±5 μm, there is also a requirement to reduce as far as possible the number of locations at which this alignment accuracy is required.

Further, electronic instruments are required to be more compact and lightweight, as a result of which, compactness, light weight, and low cost are requirements for optical modules.

B. <u>Object of the Invention</u>

The invention solves these problems. Specifically, it is an object of the invention to provide an optical module which can be made more compact and lightweight.

C. Embodiment 1 of the Invention

An optical module of this invention comprises a mounting member having a principal surface; an interconnect formed on the mounting member; and an optical element mounted on the principal surface and electrically connected to the interconnect, wherein the mounting member is an optical waveguide for guiding light emitted from the optical element or light admitted to the optical element.

In a conventional optical module, on a mounting member is mounted an optical waveguide separate from the mounting member. In contradistinction, this invention has the mounting member and optical waveguide as an integral member. The optical module can therefore be made thinner. As a result, the optical module can be made more compact and lightweight.

In a conventional optical module, there are three members involved in the positioning: the mounting member, the optical waveguide, and the optical element. On the other hand, in this invention there are two: the mounting member (optical waveguide) and the optical element. Therefore, in this invention, the optical element positioning is made easier, and the bonding accuracy can be improved.

A light-admitting aperture or light-emitting aperture of the optical element may be disposed opposing the principal surface. Such an optical element may be, for example, a surface-emission laser.

A light-reflecting member may be provided on the optical waveguide. Through the light-reflecting member, light can be transmitted between the optical element and the optical waveguide.

An optical module of another aspect of this invention comprises an optical element for emitting or admitting light; and an optical waveguide having a principal surface, with the

optical element mounted on the principal surface, for guiding light emitted from the optical element or light admitted to the optical element.

The optical element and the optical waveguide may be fixed with an adhesive member having light transmitting characteristics interposed between the optical element and the optical waveguide in such a way that the position of emission or admission of light of the optical element opposes the optical waveguide, and be subjected to bare chip mounting.

Bare chip mounting allows more compact and lightweight design than with package mounting. In this aspect, since the optical element is subjected to bare chip mounting, the optical module can be made more compact and lightweight. The optical element and optical waveguide and are fixed by an adhesive member having light transmitting characteristics. By virtue of this, the optical element and the optical waveguide can be fixed and an optical path between the optical element and the optical waveguide can be assured.

The optical waveguide may have a modifying portion whereby the direction of progress of the light is changed; and the optical element may be positioned to overlie the modifying portion. By virtue of this, the direction of progress of the light can be efficiently changed.

The modifying portion is formed in the optical waveguide, and the optical element is directly mounted to the optical waveguide having the modifying portion. By virtue of this, the relative positioning (distance and the like) of the optical element and modifying portion can always be maintained constant, as a result of which there can be no loss of focus with respect to the modifying portion. On the other hand, in the prior art, the optical element is not mounted directly on the optical waveguide, and therefore the optical waveguide and optical element are disposed separated from each other. For this reason, when both are fixed with respect to other elements, there is a possibility of relative movement between the two.

Therefore, even if the positioning operation is achieved, thereafter there is the possibility of a change in the positioning caused by various influences (heat, external pressure, and the like).

It should be noted that in the expression "positioned to overlie the modifying portion," the term "overlie" indicates that when seen projected from the optical element or modifying portion, both are disposed in positions such that it appears that both coincide.

On the principal surface of the optical waveguide may be further mounted a semiconductor element in addition to the optical element, and the optical element and the semiconductor element may be integrally sealed with a resin.

If the optical element and semiconductor element are mounted on the principal surface of the optical waveguide, the interconnect connecting the two may be made shorted. The formation of the interconnect on the mounting substrate can be single layer, and the interconnect formation is made easier. If the optical element and semiconductor element are integrally sealed with a resin, the strength of the optical module can be improved. If the optical element and semiconductor element are hybrid, the degree of integration of the optical module can be improved. By the improvement of this degree of integration, the cost can be lowered.

The resin may have light blocking characteristics. If light impinges on the semiconductor element, faulty operation of the semiconductor element is possible. By sealing the semiconductor element with a resin having light blocking characteristics, faulty operation can be prevented.

The semiconductor element may have a function of driving the optical element.

Since the optical element and the semiconductor element driving or controlling the optical element are mounted on the principal surface of the optical waveguide, the optical module can be made a module of high added value. A higher degree of integration of the optical module and a lower cost can also be achieved.

A circuit may be laminated directly on the principal surface of the optical waveguide. If a circuit is laminated directly on the principal surface of the optical waveguide, the mounting of the semiconductor element is not required. Therefore, it is no longer necessary to consider the reliability of connection between different components. In respect of connections between integrated circuit elements, the connections can be eliminated, and by virtue of this, the interconnect impedance characteristics and noise characteristics can be improved, while the effect of delays can be held to a minimum. The degree of integration on the principal surface of the optical waveguide can be improved, and a high degree of integration of the optical module and low cost can be achieved.

An optical module according to another aspect of the invention comprises an optical element; and a mounting member which has a function of an optical waveguide for guiding light emitted from the optical element or light admitted to the optical element and is electrically connected to the optical element or a semiconductor element associated therewith.

An optical module according to yet another aspect of this invention comprises a mounting member having a principal surface and a lateral surface; and an optical element mounted on the principal surface, wherein the mounting member has a function of an optical waveguide, and an optical input/output terminal for the optical waveguide is provided on the lateral surface of the mounting member.

It should be noted that an optical input/output terminal means a terminal at which light is input, or a terminal at which light is output, or a terminal at which light is input and/or output.

It should be noted that optical elements include both elements which emit light and elements which receive light. The mounting member may be in plate, film, or other form, as long as it allows the optical element to be mounted.

D. The Claimed Invention

1. Claim 1

Claim 1 recites an optical module comprising a mounting member (10) having a principal surface, said mounting member (10) entirely made of glass and having a core (12) and a cladding (14) formed therein, said cladding (14) having its surface to form said principal surface in whole. An interconnect (16a) formed on the mounting member and an optical element (22) mounted on the principal surface and electrically connected to the interconnect (16a). A semiconductor (20) for driving the optical element with the semiconductor mounted on the principal surface, where the mounting member (10) is an optical waveguide for guiding light emitted from the optical element or light admitted to the optical element.

2. Claims 2 and 3

Additional features of the invention recited in claim 1 are found in dependent claims 2 and 3.

Claim 2 recites that a light-admitting aperture or light-emitting aperture of the optical element is disposed opposing the principal surface.

Claim 3 recites that a light-reflecting member is provided on the optical waveguide and light is transmitted between the optical element and the optical waveguide through the light-reflecting member.

3. Claim 4

Claim 4 recites an optical element for emitting or admitting light which has an optical waveguide (10) entirely made of glass and having a core (12) and a cladding (14) formed therein and having a principal surface. The optical element (22) is mounted on the principal surface and guides light emitted from the optical element or light admitted to the optical

element. A semiconductor element (20) drives the optical element and the semiconductor element (20) is mounted on the principal surface.

4. Claims 5-12 and 16

Additional features of the invention recited in claim 4 are found in dependent claims 5-12 and 16.

Claim 5 recites the optical element (22) and the optical waveguide (10) are fixed with an adhesive member having light transmitting characteristics interposed between the optical element (22) and the optical waveguide (10) in such a way that the position of emission or admission of light from the optical element opposes the optical waveguide and are subjected to bare chip mounting.

Claim 6 recites that the optical waveguide (10) has a modifying portion whereby the direction of progress of the light is changed and the optical element (22) is positioned to overlie the modifying portion.

Claim 7 recites that the optical element (22) and the semiconductor element (20) are integrally sealed with a resin (36).

Claim 8 recites that the optical element (22) and the semiconductor element (20) are integrally sealed with a resin (36).

Claim 9 recites that the optical element (22) and the semiconductor element (20) are integrally sealed with a resin (36).

Claim 10 recites that the resin (36) has light blocking characteristics.

Claim 11 recites that the resin (36) has light blocking characteristics.

Claim 12 recites that the resin (36) has light blocking characteristics.

Claim 16 recites that a circuit is laminated directly on the principal surface.

5. **Claim 17**

Claim 17 recites an optical element (22) and a mounting member (10) with the mounting member (10) entirely made of glass and having a core (12) and a cladding (14) formed therein to have a function of an optical waveguide for guiding light emitted from the optical element or light admitted to the optical element. The mounting member (10) is electrically connected to the optical element (22) or a semiconductor element (20) associated with the optical element. A semiconductor element (20) drives the optical element (22) and the semiconductor element (20) is mounted on the mounting member (10).

6. **Claim 18**

Claim 18 recites a mounting member (10) having a principal surface and a lateral surface with the mounting member (10) entirely made of glass and having a core (12) and a cladding (14) formed therein. An optical element (22) is mounted on the principal surface and a semiconductor element (20) drives the optical element with the semiconductor element (20) mounted on the principal surface. The mounting member (10) has a function of an optical waveguide and an optical input/output terminal for said optical waveguide is provided on said lateral surface.

III. ISSUES AND REJECTIONS

The June 16, 2003 Office Action rejects claims 1-4 and 16-18 under 35 U.S.C. §102(b) as anticipated by Hayashi "An Innovative Bonding Technique for Optical Chips using Solder Bumps that Eliminate Chip Positioning Adjustments" (hereinafter "Hayashi"); and rejects claims 5-12 under 35 U.S.C. §103(a) as unpatentable over Hayashi in view of U.S. Patent No. 5,940,550 to Plickert et al (hereinafter "Plickert").

Thus, the issues on appeal are whether:

A) claims 1-4 and 16-18 are anticipated under 35 U.S.C. §102(b) over Hayashi; and

B) claims 5-12 would have been obvious to one of ordinary skill in the art under 35 U.S.C. §103 over Hayashi in view of Plickert.

IV. GROUPING OF CLAIMS

Each claim of this patent application is separately patentable, and upon issuance of a patent will be entitled to a separate presumption of validity under 35 U.S.C. §282. For convenience in the handling of this Appeal, the claims are grouped as follows:

Group I, Claim 1;

Group II, Claim 2;

Group III, Claim 3;

Group IV, Claim 4;

Group V, Claim 16;

Group VI, Claim 17;

Group VII, Claim 18;

Group VIII, Claim 5;

Group IX, Claim 6; and

Group X, Claims 7-12.

Each of Groups I-X will be argued separately in the following arguments. The groups do not stand or fall together.

V. ARGUMENT

A. The Law

1. Law Regarding Factual Inquiries to Determine Novelty and Obviousness/Non-Obviousness

In order to be anticipatory under 35 U.S.C. §102, a prior art reference must have each and every feature set forth in the claims. This rule was not properly applied by the Examiner

in formulating the rejection of claims 1-4 and 16-18. Particularly, the differences between the prior art and the claims were not properly determined.

Several basic factual inquiries must be made to determine obviousness or non-obviousness of patent application claims under 35 U.S.C. §103. These factual inquiries are set forth in Graham v. John Deere Co., 383 U.S. 1, 17, 148 USPQ 459, 467 (1996):

> Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or non-obviousness of the subject matter is determined.

As stated by the Federal Circuit in In re Ochiai, 37 USPQ2d 1127, 1131 (Fed. Cir. 1995):

> [t]he test of obviousness *vel non* is statutory. It requires that one compare the claim's subject matter as a whole with the prior art to which the subject matter pertains. 35 U.S.C. §103.
>
> The inquiry is thus highly fact-specific by design.... When the references cited by the Examiner fail to establish a *prima facie* case of obviousness, the rejection is improper and will be overturned. In re Fine, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). (Emphasis added.)

In rejecting claims under 35 U.S.C. §103, an Examiner bears an initial burden of presenting a *prima facie* case of obviousness. A *prima facie* case of obviousness is established only if the teachings of the prior art would have suggested the claimed subject matter to a person or ordinary skill in the art. If an Examiner fails to establish a *prima facie* case, the rejection is improper and will be overturned. See In re Rijckaert, 9 F.3d 1531, 28 USPQ2d (Fed. Cir. 1993). "If examination ... does not produce a *prima facie* case of unpatentability, then without more the applicant is entitled to the grant of the patent." In re Oetiker, 977 F.2d 1443, 1445-1446, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992).

B. Rejections Under 35 U.S.C. §102(b)

1. Position Asserted in the June 16, 2003 Office Action

The Office Action rejects claims 1-4 and 16-18 under 35 U.S.C. §102(b) as anticipated by Hayashi, "An Innovative Bonding Technique for Optical Chips using Solder Bumps that Eliminate Chip Positioning Adjustments". Specifically, page 2 of the Office Action asserts as follows:

> Hayashi discloses (see Figures 2(a), 2(c)) an optical module comprising a mounting member having a principal surface, and a lateral surface as shown in Figures 2(a) and 2(c) and entirely made of glass as shown in Figure 3 and as described in page 226, lines 25-32 or an optical waveguide entirely made of glass and having a core and cladding formed therein, said cladding having its surface to form said principal surface in whole as shown in Figure 2(a); an interconnect (see "electrical interconnection in Figure 2(c)) formed on said mounting member and an optical element (see "optical chip" in Figure 2(c)) mounted on said principal surface and electrically connected to said interconnect and a semiconductor element (see "electrical chip" in Figure 2(c)) driving said optical element, said semiconductor element mounted on said principal surface as shown in Figure 2(c), wherein said mounting member is an optical waveguide for guiding light emitted from said optical element or light admitted to said optical element and functions as an optical input/output terminal for said optical waveguide provided on said lateral surface as described on page 226, paragraph III and as shown in Figures 2(a)-2(c).

In response to Appellants' arguments asserted in the April 10, 2003 Amendment, the Office Action at page 5 asserts as follows:

> Applicant argues that the prior art, Hayashi does not disclose a mounting member having cladding formed therein with the cladding having its surface to form the principal surface in whole but instead discloses a waveguide provided in a groove formed in a mounting member which only forms a portion of the principal surface. In response to this argument, the Examiner would like to point out that Hayashi does teach a mounting member or optical waveguide made entirely of glass and an core and cladding formed therein which is a typical planar waveguide configuration. The feature of the cladding having its surface to form said principal surface in whole is seen as an inherent teaching of Hayashi because in a planar

> waveguide such as Hayashi, the mounting member is made of a material (i.e., glass) and the core is a section formed in the mounting member by doping the section so that it has a higher refractive index than the surrounding material and so the surrounding material forms the cladding and forms the principal surface in whole as shown in Figures 2(a) and 2(c) of Hayashi.

2. <u>Hayashi</u>

The Hayashi article describes chip bonding experiments that demonstrate the accuracy of solder bump techniques. The concept and the advantages of the techniques are first reviewed and then chip bonding experiments using Si chips clarify the alignment accuracy of the techniques. Dummy chips are also assembled and subjected to thermal cycling to test the long term stability of the alignment accuracy.

Fig. 2A of Hayashi illustrates how a photodetector could be bonded onto an optoelectronic circuit board with an optical waveguide (20). Solder bumps are provided on the photodetector and solderable paths are on the circuit board.

As shown in Fig. 2B, when conventional positioning adjustments of optical chips are used the positioning of chips proceed through a sequence of adjustments and manufacturing throughput falls off dramatically as the number of optical chips increases. With the solder bump technique, many optical chips are simultaneously aligned.

As such, some technique is needed to reduce the complexity of coupling between optical waveguides and optical fibers. Hayashi discloses that the solder bump technique in combination with a precision V-groove technique can solve this problem.

3. <u>Claim 1 is Distinguishable Over Hayashi</u>

The invention recited in claim 1 cannot be anticipated by Hayashi. For example, Hayashi does not disclose a mounting member having a principal surface with a mounting member made of glass and having a core and cladding with the cladding having its surface to

form the principal surface in whole, and the mounting member is an optical waveguide for guiding light, as claimed in claim 1.

Hayashi does not disclose the features as recited in claim 1. Instead, Hayashi discloses an optical waveguide on a mounting member with a groove formed in the mounting member. Thus, the waveguide forms only a portion of the principal surface.

Further, Hayashi discloses on page 226, lines 19-23 that a technique is needed to reduce the complexity of coupling between optical waveguides on the boards and optical fibers. It has already been demonstrated that the solder bump technique, in combination with a precision V-groove technique, can solve this problem. That is, Hayashi inherently teaches positioning an optical fiber in a V-groove, but does not imply that the core is a section formed in the mounting member by doping the section.

It is therefore respectfully submitted that Appellants' claimed invention is significantly different and cannot be anticipated by Hayashi.

4. Dependent Claim 2 is Distinguishable Over Hayashi

Claim 2 recites a light-admitting aperture or light-emitting aperture of the optical element is disposed opposing the principal surface. Claim 2, which depends from claim 1 is also distinguishable over Hayashi for at least the reasons discussed above with respect to claim 1 as well as for the additional features it recites.

5. Dependent Claim 3 is Distinguishable Over Hayashi

Claim 3 depends from claim 1. Dependent claim 3 is also distinguishable over Hayashi for at least the reasons discussed above with respect to claim 1, as well as for the additional features it recites. Further, dependent claim 3 is separately patentable for at least the reasons discussed below.

Hayashi does not disclose a light-reflecting member provided on the optical waveguide and the light is transmitted between the optical element and the optical waveguide through the light-reflecting member, as claimed in claim 3.

There is no particular disclosure in Hayashi, nor does the Examiner direct the Applicants' attention to a particular teaching of a light-reflecting member provided on the optical waveguide.

That is, the light transmitting characteristics are interposed between the optical element and the optical waveguide in such a way that the position of emission or admission of light of the optical element opposes the optical waveguide and is subject to bare chip mounting. Therefore, bare chip mounting allows more compact and lightweight design than with package mounting. Accordingly, since the optical element is subjected to bare chip mounting, the optical module can be made more compact and lightweight.

6. Claim 4 is Distinguishable Over Hayashi

The invention recited in claim 4 cannot be anticipated by Hayashi. For example, Hayashi does not disclose an optical waveguide entirely made of glass and having a core and cladding formed therein with the cladding having its surface to form the principal surface in whole, and an optical element mounted on the principal surface for guiding light, as claimed in claim 4.

Hayashi does not disclose the features as recited in claim 4. Instead, Hayashi discloses an optical waveguide on a mounting member with a groove formed in the mounting member. Thus, the waveguide forms only a portion of the principal surface.

Further, Hayashi discloses on page 226, lines 19-23 that a technique is needed to reduce the complexity of coupling between optical waveguides on the boards and optical fibers. It has already been demonstrated that the solder bump technique, in combination with a precision V-groove technique, can solve this problem. That is, Hayashi inherently teaches

positioning an optical fiber in a V-groove, but does not imply that the core is a section formed in the mounting member by doping the section.

It is therefore respectfully submitted that Appellants' claimed invention is significantly different and cannot be anticipated by Hayashi.

7. Dependent Claim 16 is Distinguishable Over Hayashi

Claim 16 recites a circuit is laminated directly on the principal surface. Claim 16, which depends from claim 4 is also distinguishable over Hayashi for at least the reasons discussed above with respect to claim 4 as well as for the additional features it recites.

8. Claim 17 is Distinguishable Over Hayashi

The invention recited in claim 17 cannot be anticipated by Hayashi. For example, Hayashi does not disclose a mounting member made of glass and having a core and cladding and a principal surface with the cladding having its surface to form the principal surface in whole, as claimed in claim 17.

Hayashi does not disclose the features as recited in claim 17. Instead, Hayashi discloses an optical waveguide on a mounting member with a groove formed in the mounting member. Thus, the waveguide forms only a portion of the principal surface.

Further, Hayashi discloses on page 226, lines 19-23 that a technique is needed to reduce the complexity of coupling between optical waveguides on the boards and optical fibers. It has already been demonstrated that the solder bump technique, in combination with a precision V-groove technique, can solve this problem. That is, Hayashi inherently teaches positioning an optical fiber in a V-groove, but does not imply that the core is a section formed in the mounting member by doping the section.

It is therefore respectfully submitted that Appellants' claimed invention is significantly different and cannot be anticipated by Hayashi.

9. Claim 18 is Distinguishable Over Hayashi

The invention recited in claim 18 cannot be anticipated by Hayashi. For example, Hayashi does not disclose a mounting member having a principal surface and a lateral surface, with the mounting member made of glass and having a core and cladding with the cladding having its surface to form the principal surface in whole, and the mounting member is an optical waveguide for guiding light and a terminal for the optical waveguide is provided on said lateral surface, as claimed in claim 18.

Hayashi does not disclose the features as recited in claim 18. Instead, Hayashi discloses an optical waveguide on a mounting member with a groove formed in the mounting member. Thus, the waveguide forms only a portion of the principal surface.

Further, Hayashi discloses on page 226, lines 19-23 that a technique is needed to reduce the complexity of coupling between optical waveguides on the boards and optical fibers. It has already been demonstrated that the solder bump technique, in combination with a precision V-groove technique, can solve this problem. That is, Hayashi inherently teaches positioning an optical fiber in a V-groove, but does not imply that the core is a section formed in the mounting member by doping the section.

It is therefore respectfully submitted that Appellants' claimed invention is significantly different and cannot be anticipated by Hayashi.

C. Rejections Under 35 U.S.C. §103

1. Position Asserted in the June 16, 2003 Office Action

The Office Action rejects claims 5-12 under 35 U.S.C. §103(a) as unpatentable over Hayashi, "An Innovative Bonding Technique for Optical Chips using Solder Bumps that Eliminate Chip Positioning Adjustments" in view of U.S. Patent No. 5,940,550 to Plickert et al. Specifically, the Office Action asserts at page 4:

> that the optical element and said optical waveguide are fixed with an adhesive member (26) having light transmitting characteristics interposed between said optical element and said optical waveguide in such a way that the position of emission or admission of light of said optical element opposes said optical waveguide and are subjected to bare chip mounting as shown in Fig. 1 and described in col. 4, lines 25-29. Regarding claims 7-9, Plickert et al. teaches that said optical element and said semiconductor element are integrally sealed with a resin as shown in Fig. 1 and as described in col. 3, lines 54-65 and col. 4, lines 25-29. Regarding claims 10-12, Plickert et al. teaches that the resin has light blocking characteristics as described in col. 4, lines 25-29. It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize the adhesive member or resin of Plickert et al. in the optical module of Hayashi in order to protect the module.

2. Plickert

Plickert discloses an electrooptical module which includes a converter and at least one optical waveguide having an end optically coupled to the converter through a coupling gap. The optically active zones 1A-1L are assigned one end of a respective optical waveguide 3A-3L through a coupling gap 2.

A first material 20 which is permeable to light emitted by the optically active zones 1A-1L fills up the coupling gap 2 and a space 21 located behind it. The first material ends at a boundary surface 24 which encloses the mirrored optical waveguide and end surface 4G as shown in Fig. 1. A second material 26 surrounds the electrical circuit 14 and is equivalent in its basic chemical composition to the first material 20.

An end of a respective optical waveguide is coupled to an optically active zone such that light signals pass through a jacket surface of the optical waveguide and are reflected by its obliquely polished mirrored end surface in the Z direction of optical waveguide 3G.

3. Dependent Claim 5 is Distinguishable Over Hayashi in View of Plickert

Plickert does not make up for the structural and operational deficiencies of Hayashi as discussed above. For example, Plickert does not disclose an optical waveguide entirely made

of glass and having a core and cladding formed therein with the cladding having its surface to form the principal surface in whole, and an optical element mounted on the principal surface for guiding light, as claimed in claim 4. Claim 5 depends on claim 4.

Additionally, Plickert does not disclose the additional features recited in claim 5. Specifically, Plickert does not disclose that the optical element and optical waveguide are fixed with an adhesive member having light transmitting characteristics interposed between the optical element and the optical waveguide in a way that the position of emission or admission of light of said optical element opposes said optical waveguide, as claimed in claim 5.

Instead, the "adhesive" member (26) asserted by the Office Action merely surrounds the electrical circuit 14 and is the basic composition of the first material 20. Thus, there is no teaching or disclosure that the adhesive member is interposed between an optical element and an optical waveguide of Plickert.

4. Dependent Claim 6 is Distinguishable Over Hayashi in View of Plickert

Plickert does not make up for the structural and operational deficiencies of Hayashi as discussed above. For example, Plickert does not disclose an optical waveguide entirely made of glass and having a core and cladding formed therein with the cladding having its surface to form the principal surface in whole, and an optical element mounted on the principal surface for guiding light, as claimed in claim 4. Claim 6 depends on claim 4.

Further, Plickert does not disclose additional features of claim 6. Specifically, Plickert does not disclose that the optical waveguide has a modifying portion whereby the direction of progress of the light is changed and where the optical element is positioned to overlie the modifying portion, as claimed in claim 6.

There is no specific disclosure, nor does Examiner direct the Applicants' attention to a specific disclosure for a modifying portion as part of the optical waveguide. That is, the modifying portion is formed in the optical waveguide, and the optical element is directly mounted to the optical waveguide having the modifying portion. By virtue of this, the relative positioning of the optical element and modifying portion can always be maintained constant, as a result of which there can be no loss of focus with respect to the modifying portion.

5. Dependent Claims 7-12 are Distinguishable <u>Over Hayashi in View of Plickert</u>

The invention recited in claim 4 cannot be anticipated by Hayashi. As discussed previously, Hayashi does not disclose an optical waveguide entirely made of glass and having a core and cladding formed therein with the cladding having its surface to form the principal surface in whole, and an optical element mounted on the principal surface for guiding light, as claimed in claim 4. Accordingly, dependent claims 7-12 are distinguishable over Hayashi for at least the reasons set forth above, with respect to claim 4 as well as for the additional features they recite.

For example, claims 7-9 recite that the optical element and said semiconductor element are integrally sealed with a resin. Claims 10-12 recite that the resin has light blocking characteristics.

D. <u>Summary</u>

The invention recited in claims 1, 4, 17 and 18 is structurally different from Hayashi for numerous reasons. For example, Hayashi does not disclose that a mounting member has a principal surface with the mounting member made of glass and having a core and cladding with the cladding having its surface to form the principal surface in whole, and the mounting member is an optical waveguide for guiding light.

In contrast, Hayashi discloses an optical waveguide on a mounting member with a groove formed in the mounting member. Thus, the waveguide forms only a portion of the principal surface.

Further, Hayashi discloses on page 226, lines 19-23 that a technique is needed to reduce the complexity of coupling between optical waveguides on the boards and optical fibers. It has already been demonstrated that the solder bump technique, in combination with a precision V-groove technique, can solve this problem. As such, Hayashi inherently teaches positioning an optical fiber in a V-groove, but does not imply that the core is a section formed in the mounting member by doping the section.

It is therefore respectfully submitted that Appellants' claimed invention is significantly different and cannot be anticipated by Hayashi.

Plickert does not make up for the structural deficiencies of Hayashi discussed above. For example, Plickert does not disclose that a mounting member has a principal surface with the mounting member made of glass and having a core and cladding with the cladding having its surface to form the principal surface in whole, and the mounting member is an optical waveguide for guiding light.

Instead, Plickert discloses an electrooptical module which includes a converter and at least one optical waveguide having an end optically coupled to the converter through a coupling gap. The optically active zones 1A-1L are assigned one end of a respective optical waveguide 3A-3L through a coupling gap 2. Plickert therefore cannot provide the advantages of the claimed invention. Hayashi and Plickert do not disclose the additional features claimed in claims 2-3, 5-12 and 16.

VI. CONCLUSION

For at least the reasons discussed above, it is respectfully submitted that claims 1-4 and 16-18 are not anticipated under 35 U.S.C. §102(b) by Hayashi, and claims 5-12 would not have been obvious under 35 U.S.C. §103 over Hayashi in view of Plickert.

For the above reasons, Appellants respectfully request this Honorable Board to reverse the rejection of the claims.

Respectfully submitted,

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Date: December 12, 2003

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Appendix A

APPENDIX A

CLAIMS:

1. An optical module comprising:

a mounting member having a principal surface, said mounting member entirely made of glass and having a core and a cladding formed therein, said cladding having its surface to form said principal surface in whole;

an interconnect formed on said mounting member;

an optical element mounted on said principal surface and electrically connected to said interconnect; and

a semiconductor element driving said optical element, said semiconductor element mounted on said principal surface,

wherein said mounting member is an optical waveguide for guiding light emitted from said optical element or light admitted to said optical element.

2. The optical module as defined in claim 1,

wherein a light-admitting aperture or light-emitting aperture of said optical element is disposed opposing said principal surface.

3. The optical module as defined in claim 2,

wherein a light-reflecting member is provided on said optical waveguide; and

wherein light is transmitted between said optical element and said optical waveguide through said light-reflecting member.

4. An optical module comprising:

an optical element for emitting or admitting light;

an optical waveguide entirely made of glass, having a core and a cladding formed therein and having a principal surface, with said optical element mounted on said

principal surface, for guiding light emitted from said optical element or light admitted to said optical element, said cladding having its surface to form said principal surface in whole; and

a semiconductor element driving said optical element, said semiconductor element mounted on said principal surface.

5. The optical module as defined in claim 4,

wherein said optical element and said optical waveguide are fixed with an adhesive member having light transmitting characteristics interposed between said optical element and said optical waveguide in such a way that the position of emission or admission of light of said optical element opposes said optical waveguide, and are subjected to bare chip mounting.

6. The optical module as defined in claim 5,

wherein said optical waveguide has a modifying portion whereby the direction of progress of said light is changed; and

wherein said optical element is positioned to overlie said modifying portion.

7. The optical module as defined in claim 4,

wherein said optical element and said semiconductor element are integrally sealed with a resin.

8. The optical module as defined in claim 5,

wherein said optical element and said semiconductor element are integrally sealed with a resin.

9. The optical module as defined in claim 6,

wherein said optical element and said semiconductor element are integrally sealed with a resin.

10. The optical module as defined in claim 7,

wherein said resin has light blocking characteristics.

11. The optical module as defined in claim 8,

wherein said resin has light blocking characteristics.

12. The optical module as defined in claim 9,

wherein said resin has light blocking characteristics.

16. The optical module as defined in claim 4,

wherein a circuit is laminated directly on said principal surface.

17. An optical module comprising:

an optical element;

a mounting member, said mounting member entirely made of glass and having a core and a cladding formed therein to have a function of an optical waveguide for guiding light emitted from said optical element or light admitted to said optical element, said mounting member electrically connected to said optical element or a semiconductor element associated with said optical element, said mounting member having a principal surface, said cladding having its surface to form said principal surface in whole; and

a semiconductor element driving said optical element, said semiconductor element mounted on said principal surface.

18. An optical module comprising:

a mounting member having a principal surface and a lateral surface, said mounting member entirely made of glass and having a core and a cladding formed therein, said cladding having its surface to form said principal surface in whole;

an optical element mounted on said principal surface; and

a semiconductor element driving said optical element, said semiconductor element mounted on said principal surface,

wherein said mounting member has a function of an optical waveguide, and an optical input/output terminal for said optical waveguide is provided on said lateral surface.